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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Federal-State Joint Board on Universal Service	)	CC Docket No. 96-45
	)	
Forward-Looking Mechanism for High Cost Support for Non-Rural LECs	)	CC Docket No. 97-160

JOINT COMMENTS OF BELLSOUTH CORPORATION, BELLSOUTH TELECOMMUNICATIONS, INC., U S WEST, INC., AND SPRINT LOCAL TELEPHONE COMPANIES TO FURTHER NOTICE OF PROPOSED RULEMAKING SECTIONS III.C.3.a-d, III.C.4

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August 8, 1997

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TABLE OF CONTENTS

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I. INTRODUCTION

In the Universal Service Order, the Commission concluded that the proper measure of cost for determining the level of universal service support is the forward-looking economic cost to construct and operate the network facilities needed to provide the services to be supported by the fund.[1] The Joint Board recommended that the Commission use a proxy model, based upon forward-looking economic costs for the provision of basic telephone service, to determine support levels for universal service.[2]

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[1] In the Matter of Federal-State Joint Board on Universal Service. CC Docket No. 96-45, Report and Order, FCC 97-157, rel. May 8, 1997 ("Universal Service Order")¶ 224; appeals pending sub noms. Celpage, Inc. v. FCC, No. 97-1399 (D.C. Cir.), COMSAT Corporation v. FCC, No. 97-1439 (D.C. Cir.), Texas Office of Public Utility Counsel, et al. v. FCC, No. 97-60421 (5th Cir.).

[2] In the Matter of Federal-State Joint Board on Universal Service, Recommended Decision, 12 FCC Rcd. 87, 231-32 ¶ 275 (1996) ("Recommended Decision").

The Commission observed that there has been significant progress in the development of the contending cost proxy models, the BCPM and the Hatfield models, since the Joint Board made its recommendation.[3] However, since the Joint Board issued its Recommended Decision, the models have been further refined.

In the Second Report of the State Members of the federal-state Joint Board,[4] three of the five State members acknowledged that both the BCPM and the Hatfield models do not satisfy all aspects of all of the criteria[5] being used to evaluate the models. However, they said:

> We now recommend that the model to be used should be the BCPM model sponsored by US West, Sprint, and Pacific Bell.
>
> * * *
>
> Our recommendation to select the BCPM, along with our suggested inputs, should not be viewed as a wholesale endorsement of all aspects of this model. Rather we believe that this model is currently the best platform from which interested parties and regulators can make collective revisions.[6]

BellSouth, U S WEST, and Sprint are now the joint sponsors of the BCPM model ("BCPM Joint Sponsors"). It has been designed for the purpose of implementing the high-cost funding support mechanism sought by the Commission.

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[3] Universal Service Order ¶¶ 235-240.

[4] State Members' Second Report on the Use of Cost Proxy Models (April 21, 1997) ("State Members' Second Report").

[5] Universal Service Order ¶ 250.

[6] State Members' Second Report at 7.

On July 18, 1997, the Commission issued a Further Notice of Proposed Rulemaking seeking comment "on the mechanism we should adopt to estimate the forward-looking economic costs that non-rural LECs would incur to provide universal service in rural, insular, and high cost areas . . . ."[7] Toward that end, the Commission has requested public examination and comment, in stages, of the model design features and input of the two contending cost proxy models.

II. PLATFORM DESIGN OF THE SWITCHING, INTEROFFICE TRUNKING, SIGNALING, AND LOCAL TANDEM COMPONENTS OF THE COST PROXY MODEL

The first stage of requested comments concerns the platform design of the switching, interoffice trunking, signaling, and local tandem components.[8]

Attachment 1 summarizes the BCPM Joint Sponsors' comments in response to the Commission's tentative conclusions and questions regarding the following subjects in the Further Notice: Platform Design Components and Input Values: (3) Switching: (a) Mix of Host, Stand-Alone, and Remote Switches; (b) Capacity Constraints; (c) Switch Costs; (d) Percent of Switch assigned to Port and to Provision of Universal Service and (4) Interoffice Trunking, Signaling, and Local Tandem Investment.

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[7] In the Matter of Federal-State Joint Board on Universal Service, Forward-Looking Mechanism for High Cost Support for Non-Rural LECs, CC Docket Nos. 96-45 and 97-160, Further Notice of Proposed Rulemaking, FCC 97-256, rel. July 18, 1997 ¶ 2 ("Further Notice").

[8] Id. ¶ 25.

III. TRANSPORT & SIGNALING MODEL DESCRIPTIONS

A description of the Transport Model [Transport Cost Proxy Model ("TCPM")] for the next version of BCPM is attached as Attachment 2.

A description of the Signaling Model [Signaling Cost Proxy Model ("SCPM")] for the next version of BCPM is attached as Attachment 3.

More detailed explanations and descriptions of the TCPM and the SCPM are under development.

A description of the Switching Model [Switching Cost Proxy Model] for the next version of BCPM will be submitted to the Commission the week of August 11, 1997.

IV. CONCLUSION

The BCPM Joint Sponsors believe that these Comments and Model Descriptions will assist the Commission to compare and contrast the structure and the input values used by the two models.

Respectfully submitted,

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August 8, 1997

ATTACHMENT 1

COMMENTS TO FURTHER NOTICE

III.C.3.a Mix of Host, Stand-Alone, and Remote Switches

Further Notice ¶122: The FCC tentatively concludes that the selected method should include an algorithm that will place host switches in certain wire centers and remotes in others.

Comment:
While we agree that the Model should place host switches in certain wire centers and remote switches in others, we are also concerned that the host and remote switching costs be reflected correctly.

Host switches and remote switches contain fixed investments (usually large) for central processing, call handling, and administrative functions. These fixed investments are traffic-sensitive because the processor's capacity is defined and limited by the number of busy hour call attempts (BHCA) and feature calls that the processor can generate. In order for a cost study to accurately determine the level of traffic-sensitive investment, it must model host and remote investments separately, and use data defining the specific host/remote relationships and switch technologies used for the area under study. Remote switches can have either higher or lower proportions of fixed costs than hosts, depending on the size and type of remote. Exclusive use of host switch investments would misrepresent the proportion of switch investment that should be attributed to ports by overstating or understating the amount of traffic-sensitive equipment (NTS) (processors and switch networks) relative to the amount of non-traffic sensitive equipment (line cards).

However, this does not imply that the costs of the fixed investments for host office administrative functions should be borne by only the customers connected directly to the host. In developing the costs of switching for universal service and Unbundled Network Elements (UNEs), the new BCPM Switch module shall apply these costs in its usage cost calculations, ensuring that appropriate sharing of fixed administrative costs at the host will occur. We simulated this in development of the previous BCPM switch curve by having the underlying SCIS data reflect the sharing of many of the host's fixed costs.

We also believe that it is not feasible, using publicly available information, to program the proxy models to optimally place hosts and remotes. Such an algorithm would necessarily require the use of confidential vendor and Local Exchange Carrier (LEC) engineering data and marketing plans. The actual decision to place each switch takes into account many location-specific factors, such as location of other switches, growth patterns, traffic patterns, marketing mix, vendor promotions, and LEC budgets. Without this information, host and remote locations cannot be optimized. We are not aware of public sources for most of this data; furthermore, much of it cannot be predicted.

Another factor which enters into deployment decisions is reliability. Consumers in all serving areas, both low and high cost, expect the same level of network reliability. An automated algorithm such as the one used in the Hatfield Model cannot take into account deployment decisions which are made to support network reliability standards.

Instead of modeling the selection of hosts and remotes, we recommend placing hosts and remotes based on data contained in the Bellcore Local Exchange Routing Guide (LERG). We believe that the LERG is the most appropriate source for this data because it is available to the public and represents the efficient "real world" placement of hosts and remotes. Other methods would necessarily require the use of confidential vendor and LEC engineering data.

Further Notice: ¶122 The FCC tentatively concludes that the host-remote arrangement is more cost-effective in many cases than employing stand-alone switches.

Comment:
We have always agreed. The host-remote arrangement provides significant economies of scale by leveraging the investments in the central processing unit, spares, and other fixed costs of the host switch. Remotes are often placed in unstaffed wire centers. The primary technical difference between a host switch and a remote switch is the presence of the central processor and administrative equipment.

Further Notice: ¶122 The FCC seeks comment on how to obtain information that would verify or refute the assertion of the models' proponents that there is no cost difference between hosts and remotes. The FCC seeks detailed comments on how to design an algorithm to predict the most cost-effective deployment of host-remote switching arrangements.

Comment:
We would like to clarify the misperception that we contend that there is no economic justification for the placement of remote switches. To the contrary, we have always maintained that the placement of remotes can save expenses by leveraging the expensive fixed resources (processor and administrative functions) of the host switch. Depending upon the host and remote provisioning characteristics, there could be significant differences in the cost per line. The new BCPM Model is built to reflect those differences.

As stated above, we believe that developing an algorithm that realistically predicts this deployment pattern is not feasible using publicly available data. Furthermore, an algorithm that effectively incorporates the accumulated knowledge of the many LEC and vendor engineering personnel would necessarily be massive and complex. The best solution would be to use LERG data or LERG-like data to determine those wire centers that are served by hosts and those served by remotes. The new BCPM Transport Cost Proxy Model uses this data to define realistic homing relationships between hosts and remotes. By using these existing host-remote relationships, the new BCPM Switch Module shall accurately reflect the economies inherent in the use of remotes.

III.C.3.b Capacity Constraints

Further Notice: ¶123 The FCC seeks comment on their contention that BCPM does not include any switch capacity limitations.

Comment:
By basing its switch costs upon the current efficient placement of switches as shown in the LERG, the new BCPM shall inherently include capacity constraints upon the number of lines, call-hour attempts, and usage (CCS). The capacity constraints shall be based upon the engineering judgment of the sponsors' subject matter experts and switch vendors' recommendations.[1] The Model may consider factors such as toll usage, feature usage, and call holding times.

Further Notice: ¶124 The FCC seeks comment on their tentative conclusion that the selected mechanism should assign more than one switch to a wire center whenever the mechanism predicts that any one of a set of capacity constraints would be exceeded.

Comment:
We agree and shall place a limitation in the Model on the maximum number of lines that can be served by a single switch. If the line count in a particular wire center exceeds this amount, multiple switches shall be installed.

Further Notice: ¶124 The FCC seeks comment on the capacity constraints that should be adopted.

Comment:
The capacity constraints upon processor usage (of which BHCA is one), traffic capacity, and lines are appropriate. However, Hatfield's measurement of these constraints is inadequate because it is too generic. Simple numeric constraints upon these factors do not recognize differences in switch architecture or the number and types of remote switches associated with each host. For example, some switches use multiple distributed

[1] Examples of manufacturer's manuals are:

Nortel DMS100 Hardware Planning Guide, Doc # 50041.08, 8/95 Issue #1
Nortel DMS Switch Evolution Transition Guide, Doc. #50111.16, 11/94, Issue #1
Available from 1 (800) 4 NORTEL, or access the Nortel Web Site: www.nortel.com

processing units while others use a single central processor. The central processing unit for distributive processing switches is not even used for many call attempts. Therefore, the use of a simplistic parameter such as 600,000 BHCA may significantly misstate the capacity of some switches. To adequately calculate processor usage, the Switch Model should consider vendor-specific engineering rules. The Model should consider usage generated by features, ISDN, and even the additional Automated Message Accounting (AMA) measurement required for UNEs, to ensure that costs for elements not associated with universal service are separately identified.

Further Notice: ¶125 The FCC agrees with the state members of the Joint Board that estimating switch investment cost is a significant unresolved problem in these Models.

Comment:
We believe that the best solution to the switching cost issue is to use outputs from an Audited LEC Switching Model (ALSM). By incorporating a switching cost curve derived from ALSM outputs, the new BCPM Model can provide accurate and granular switching investments. ALSM data is generated from exhaustive studies and forecasts of LEC traffic patterns. Each switch in the sample is "engineered" within an ALSM based on the actual algorithms and data used to build and order the switch in the real world. ALSM standards would support both universal service studies and UNE studies with accuracy and precision . The new BCPM switch curve will be more specific than that used in the previous BCPM. We shall be modeling investments for line ports, line usage, trunk usage, and features.

We are also crafting our Switch Model so that if the Commission rules that the use of an ALSM is not acceptable, we will have the flexibility to develop a switching cost inputs methodology based upon the data inputs which the Commission specifies. The Commission or any user can input total switch investments at any particular wire center and use ALSM results to apportion the total investment into the appropriate categories. This will give the model the flexibility to develop a switching cost methodology based upon the user's knowledge of total switch investments and the inherent advantages of the ALSM output to derive the detail of the investment.

Further Notice: ¶126 The FCC seeks comment on its conclusion that BCPM Model switching estimates are based on a survey of only large LECs.

Comment:
The proposed switch cost curve can be developed for small LECs as well as large LECs. The current BCPM and proposed enhanced BCPM allow separate switch investment inputs for small, medium, and large companies.

Further Notice: ¶128 The state members of the Joint Board recommend that switch investment cost should be based upon a fixed cost of $150,000 and a per line cost of $110.00.

Comment:

As mentioned above, the use of a switch cost curve which is based upon detailed engineering data, would assure that accurate switch investments are used. Characteristics of the host/remote relationships would be inherent in the curves. The statistical approaches that derive switching cost curves from historical accounting information have two fundamental deficiencies which prevent them from providing the cost of universal service. First, they do not provide enough specificity regarding cost differences between host and remote switches or cost differences between switch vendors. Second, they do not provide a sound basis for separating local usage costs from port costs, or separating universal service usage from other types of usage. ALSMs and BCPM can be applied to small LEC-supplied engineering data to compute accurate investments for small LECs.

Further Notice: ¶129 The FCC seeks comment on its conclusion that switching costs of small LECs should be higher than those of large LECs.

Comment:
This seems reasonable, since large LECs benefit from both economies of scale and volume purchase agreements not necessarily available to small LECs. Our proposed model shall contain enough specificity to reflect cost differences arising from both factors.

III.C.3.c Switch Costs

Further Notice: ¶132 The FCC tentatively concludes that the selected mechanism should use the Commission staff's estimates of switching costs.

Comment:
We disagree. The staff's estimates are not sufficiently detailed to reflect cost differences between companies and/or serving areas. They do not provide a separation of switch costs into line port, line usage, trunk usage, and features components. Data sources and models for calculating economic costs are available from switch vendors and LEC engineering and forecasting departments. However, historical accounting costs such as the staff's estimates can serve an important role as a reasonability check of forward-looking costs.

Further Notice: ¶132 The FCC seeks comment on whether the cost of growth lines should be incorporated into the switching cost estimate.

Comment:
Yes. Total Element Long Run Incremental Cost (TELRIC) includes the total cost of network elements for a period long enough to include growth lines. Growth lines are needed to maintain service quality in the face of increasing demand. Growth lines tend to be more expensive because they do not benefit from the promotional discounts that switch vendors tend to offer on complete switch replacements. The BCPM-Switch

Module process addresses this by applying separate user-definable discount factors for initial switch placements and growth jobs.

III.C.3.d Percent of Switch Assigned to Port and to Provision of Universal Service

Further Notice: ¶135 The FCC tentatively concludes that switch costs should be divided between line-side port and usage costs.

Comment:
We agree, and suggest that the switch costs should be apportioned even further to accurately portray the costs of universal service. At a minimum, switch investments should be partitioned into categories that represent the capacity limitations of the switch: line terminations, line and trunk usage, processor usage (BHCAs), and any other pertinent major capacity limitations. This is one of the reasons why we advocate the use of ALSMs. They are the only readily available cost models that can provide the necessary level of detail. Otherwise we would not be able to accurately attribute switch costs to line ports, usage, and features.

Further Notice: ¶135 The FCC tentatively concludes not to adopt either of the models' assumptions regarding the percentage of switch investment that is associated with the port.

Comment:
We agree that neither of the current models' assumptions adequately identifies the percentage of switch investment attributable to the port. We note that the new BCPM Switch Module shall contain a more detailed process which determines separate proxy investments for Line Ports, Usage, Trunk Ports, and Features.

Further Notice: ¶135 Can the FCC use the information that LECs must file in response to the *Access Charge Reform Order* to determine the percentage of switch investment to be allocated to the port function? If so, what is a reasonable percentage of switch costs to include in the port function?

Comment:
The *Access Charge Reform Order* requires "each LEC to determine the geographically-averaged portion of local switching costs that is attributable to line-side ports…and to dedicated trunk-side ports." Different models of central office switching machines have widely varying architectures, with varying proportions of costs that can be considered Non-traffic Sensitive (NTS) versus usage sensitive. To the extent that the data developed in response to the *Access Charge Reform Order* separates switch costs into functionally significant categories such as line ports, usage, trunk ports, and features, while incorporating differences due to varying switch architectures, this data can be used to validate the percentage of switch investment to be allocated to the port function.

Further Notice: ¶136 The FCC seeks comment on whether it should undertake a detailed engineering study to ascertain the portion of switch equipment associated with the port function.

Comment:
In the event that the use of ALSM outputs is not deemed appropriate, a detailed engineering study would have to be performed to determine accurately the portion of switch investment attributable to the port. A study could be constructed using the engineering models provided by the switch vendors for generating switch orders, along with discount information. We believe that such studies should include data for each switch type. The Model would necessarily incorporate some prediction of the mixture of switch types for each LEC. We caution, however, that most of the data necessary for such a study is considered confidential by switch vendors.

Further Notice: ¶137 The FCC tentatively concludes that all of the port cost and a percentage of the usage cost are costs of providing universal service.

Comment:
We agree that all of the line port costs and local usage costs are costs of providing universal service.

Further Notice: ¶137 The FCC tentatively concludes that the percentage of the usage cost that should be assigned to the cost of providing universal service should be determined by the amount of local usage included in the definition of supported services that the FCC will adopt, as a percentage of total usage that the Model predicts on the network.

Comment:
We agree, provided that the identification of *total* usage cost is based upon sound engineering studies and appropriate public policy.

III.C.4 Interoffice Trunking, Signaling, and Local Tandem Investment

Further Notice: ¶139 The FCC recognizes two uses for interoffice trunking, signaling, and local tandem facilities: (1) the completion of local calls; and (2) transport to an Interexchange Carrier (IXC) point of presence (POP).

Comment:
There are uses for these facilities which fall beyond the scope of local call completion for universal service and transport to the IXC POP. For example, vertical services such as CLASS make extensive use of the signaling network. The model selected to determine usage costs should be sufficiently detailed to identify these uses separately from universal

service. Otherwise, universal service would receive a higher level of support than necessary.

Further Notice: ¶140 BCPM uses a simple multiplier to estimate the portion of total interoffice trunking, signaling, and local tandem costs that should be attributed to supported services. Hatfield treats these facilities on a more disaggregated basis.

Comment:
(See the second comment to ¶141.)

Further Notice: ¶141 The FCC tentatively concludes that the Model should calculate specific cost estimates for the interoffice elements necessary to provide these functionalities.

Comment:
We agree. The new BCPM will incorporate a new enhanced Transport Cost Proxy Model (TCPM) module that develops forward-looking transport costs utilizing SONET technology, based upon the LERG. The new transport module shall determine the universal service cost or TELRIC of host-remote and host-tandem interoffice transport. With LERG data or "LERG-like" data we can determine which remotes home off which hosts and which hosts home off which tandems. Because we use existing homing relationships, we know that viable transport media and routes exist and should be the starting point for any forward looking cost study. Modeling the existing transport routes is critical because it ensures that the routes chosen are feasible, given issues such as topography and rights of way involving jurisdictional boundaries.

TCPM takes as input the V&H coordinates, number of lines, and traffic characteristics for all existing switches in a study area. The Model contains sophisticated optimization algorithms that determine the most efficient ring configuration for the specified host and remote locations, numbers of access lines, and traffic characteristics. Within the module, algorithms are utilized that optimize the distance of transport on the ring as well as determine the most efficient SONET bandwidth (OC3, OC12, OC48) associated with the traffic demand. All of the transport cost impacting characteristics can be edited by the user in the development of the transport cost associated with USF and UNE's.

The new BCPM Signaling Cost Proxy Module (SCPM) shall produce a per line signaling investment required to create the signaling portion of the telecommunications network. The Model reflects the forward looking signaling network based on the use of Common Channel Signaling (CCS) and Signaling System 7 (SS7) protocol. SCPM is a superior model for signaling investments because it is based upon actual deployments of signaling network elements such as Service Switching Points (SSP), Signal Transfer Points (STP) and Service Control Points (SCP). SCPM supports up to five different STP models, each with different processor capabilities and pricing. All necessary 56 Kbps signaling links, used to transfer messages between elements of the network are included. In addition, SCPM can model up to six different central office switch profiles, representing monthly signaling activity for large, small, metro, rural, or tandem switches. Hatfield, by contrast, allows only the input of simplistic capacity cost type parameters for signaling investments, with no attempt to differentiate by switch or market type.

Further Notice: ¶141 The FCC seeks comments on its concern that Hatfield can generate cost estimates at this level of specificity, but BCPM cannot. The FCC seeks comment on its tentative conclusion that only Hatfield's platform is currently adequate. The FCC also seeks comment on the accuracy of Hatfield's transport algorithm.

Comment:
The new BCPM can indeed calculate the specific cost elements needed for interoffice trunking, signaling, and local tandem facilities. Although the Hatfield algorithm is more detailed than the existing BCPM, the enhanced BCPM will provide more specific and accurate cost elements than either of the previous Models.

The Hatfield algorithm does not create a realistic model of the interoffice network because it does not model the homing relationships between remotes and hosts and hosts to tandems. Nor does the Hatfield Model consider the traffic characteristics of specific nodes on the network. TCPM uses detailed LERG and associated access line data to define the node configurations and traffic characteristics. TCPM is also a realistic three dimensional model because it accurately portrays the hierarchy of transport components of the network along with individual node characteristics.

The Hatfield algorithm is unrealistic because it does not take "real world" constraints into account. It does not provide for route redundancy to remote offices, nor does it recognize diverse routing requirements for small "off ring" offices. These redundancy and diversity features of the network provide the reliability which consumers demand. As a result, Hatfield understates the route distances required to connect the offices.

ATTACHMENT 2

Transport Cost Proxy Model

I. Overview of Model

The Transport Cost Proxy Model (TCPM) is a new enhanced transport module that develops forward-looking transport cost utilizing SONET technology. TCPM can determine the Total Element Long Run Incremental Cost (TELRIC) of host-remote and host-tandem interoffice transport. TCPM utilizes data regarding remotes and the corresponding host office that the respective remote homes off of, and data on hosts and the corresponding tandems that the respective host switch homes off of. This data enables TCPM to use today's homing relationships as the appropriate starting point for a meaningful forward-looking costing application of transport that uses reality as its foundation. In addition, TCPM uses V&H coordinates, number of working lines, and traffic characteristics for all existing switches in a study area. The Model contains sophisticated optimization algorithms that determine the most efficient ring configuration by minimizing the distance of transport and utilizing efficient SONET bandwidth (OC3, OC12, OC48), given the specified host and remote locations, number of access lines, and traffic characteristics. Furthermore, the Model provides for redundancy via what is commonly referred to as self-healing rings. This route redundancy extends to remote offices.

The Model is extremely flexible, permitting the user to edit all of the transport cost impacting characteristics in the development of the transport cost associated with both universal service and unbundled network elements (UNEs). Furthermore, TCPM permits computing transport costs for universal service for an area as small as a single exchange, i.e. Extended Area Service (EAS)/Intraexchange calls only.

TCPM is an Excel spreadsheet model. The actual cost calculations are performed by the Sprint-LTD Transport Cost Model, Version 7.6.1, which is embedded within the TCPM. The ring building logic, the interface to the Sprint Model, and the user interface were developed by Financial Strategies Group for an industry task force formed to enhance further the capabilities of the Benchmark Cost Proxy Model (BCPM).

II. Purpose

The TCPM was built as an adjunct to BCPM to provide an estimate of forward-looking transport costs associated with universal service obligations. In addition, TCPM provides estimates of TELRIC of interoffice transport for use in Federal and State regulatory proceedings addressing the unbundling of network elements.

III. Features

The following highlights certain features of TCPM. This model:

1. Determines the number of rings to be built and the sequences of nodes on the ring;
2. Allows the user to move nodes from one ring to another and to change the sequence of nodes on a ring;
3. Allows the user to edit the number of DS1s and route miles by segment;
4. Allows the user to run the Sprint model for a particular ring, thereby enabling the user to trace the cost calculations through the logic of the Sprint model;
5. Allows the user to cycle through all of the rings, passing the necessary data for each ring to the Sprint model;
6. Provides reports: a) transport cost results for all of the rings; b) transport configuration for all of the rings; and c) universal service transport cost on a per line basis; and
7. Maps the nodes subtending a particular host or tandem.

IV. Assumptions

A. All remote offices are connected to their respective host offices via SONET rings (if there is only one remote a folded ring is assumed). All host offices are connected to their respective tandems via SONET rings.
B. Unidirectional SONET deployment is assumed.

V. Data Inputs

The model requires an input file containing the following information for each switch in the geographic area to be studied (state or study area):

A. The Operating Company Number;
B. The Local Name of the switch;
C. The eleven digit CLLI code of the switch;
D. The V&H coordinates of the switch;
E. The CLLI code of the tandem serving the switch;
F. For remote offices the CLLI code of the Host;
G. The number of access lines served by the switch; and
H. The V&H coordinates of the host (if a remote office) or tandem.

The records must be sorted to list each host office followed by all of its remote offices, and each tandem followed by each of its subtending offices. (Note: a host office with remotes will appear on this list twice, once with its remotes and once with its associated tandem). A utility program is available to assist in the creation of this input file.

VI. User Adjustable Inputs

The user may provide the following specifications to the Model, or the specified default values may be used for the following variables:

A. The maximum number of nodes per ring;
B. The airline miles to route miles factor;
C. The line to trunk factor;
D. The tandem trunk factor;
E. The ratio of Special access lines to switched lines;
F. The size of SONET systems available and the maximum fill % for each;
G. The assumed number of minutes of traffic per DS1;
H. Whether or not route diversity is assumed in the case of a folded (two point) ring;
I. The maximum distance between rings allowed without requiring repeaters;
J. EAS/Exchange percentage of minutes of use; and
K. Material Costs.

VII. Methodology - Building the Rings

The Model uses the following algorithm to create a forward-looking ring connecting all remotes to their hosts and hosts to their tandem.

A. If there are less than four nodes, including the host, stop. (A ring with only three nodes is by definition optimized.)
B. Sort the remaining nodes in order of distance from the host.
C. Find the two non-collocated nodes that are nearest to the host.
D. Define a 3 segment ring connecting the host and these two points, (in the attached diagram the host is point A, the other two points are B and C).
E. Find the next nearest node to the host (labeled D in the diagram).
F. Determine the distance from the new point to each current point on the ring (AD, BD and CD).
G. For each segment on the ring, calculate the sum of the distances from the new point to each of the endpoints of that segment, less the length of the segment.
    1. AD + BD - AB
    2. AD + CD - AC
    3. BD + CD - BC
H. Choose the segment with the shortest net distance in step G. In our example, this would be number 2 - segment AC.
I. Replace this segment with two new segments connecting the new node to the end points (so the ring now goes from A to B to C to D and back to A).

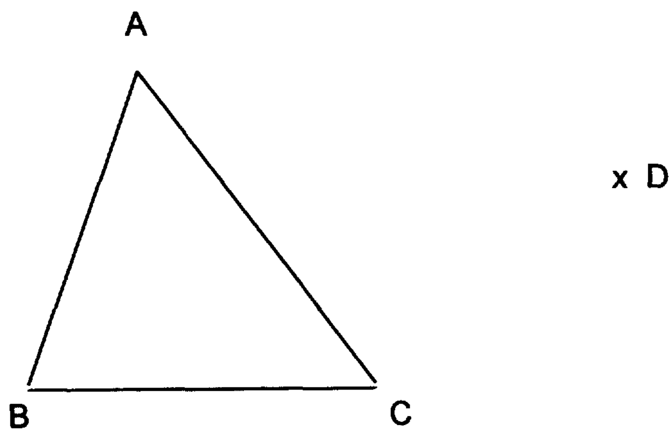

Diagram 1 - Step E

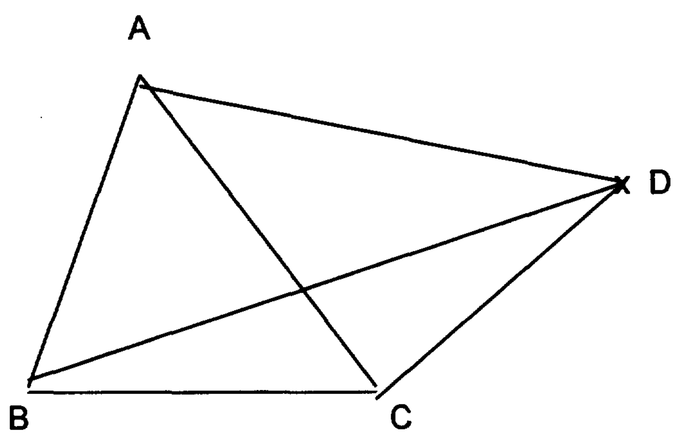

Diagram 2 - Step F

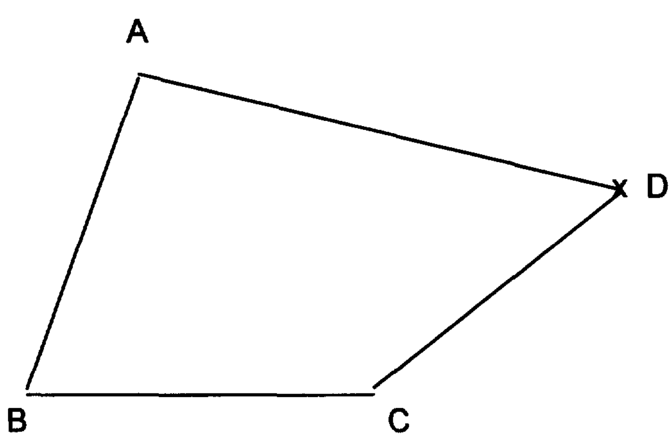

Diagram 3 - Step I

J. If there are more nodes to include, return to step E.

K. If the number of nodes exceeds the user specified maximum:
   1. Divide the number of nodes by the maximum and round up to determine the number of rings that are needed.
   2. Divide the number of nodes by the number of rings to equalize the rings.
   3. Starting at the host, traverse the ring until the number of nodes determined in step 2 have been passed.
   4. Replace the next segment with a new segment from the current node back to the host, and a segment from the host to the next node in the sequence.
   5. If more than 2 rings, repeat steps 3 and 4 until all rings are built.

VIII. Methodology - Sizing the Rings

For each ring the Model performs the following calculations:

A. Calculate the total number of switched access lines served by the ring.
B. Divide this number by the line to trunk (or tandem trunk) factor to determine the number of DS0 trunks required.
C. Divide this number by 24 to determine the number of DS1s required.
D. Multiply the number of switched access lines by the special access factor to determine the number of equivalent DS0 trunks required for special access circuits.
E. Divide this number by 24 to determine the number of DS1s required for special access.
F. Add the number of DS0s from steps B and D to get total DS0s.
G. Add the number of DS1s from steps C and E to get total DS1s.
H. Use the Ring Size Table on the control page to determine the minimum size of the ring required to serve these DS1s.
I. Use the Ring Size Table to find the total DS0 capacity of this ring.
J. Divide the total capacity by the required DS0s to determine the fill.

IX. Methodology - Costing the Rings

For each ring, the beginning and endpoints of each segment, the mileage between, the ring size (OC3, OC12 or OC48), and the fill factor are passed to the costing logic. If any of the segments are more than 45 miles, an appropriate number of repeaters is specified.

The costing logic determines the investment required from the ring characteristics and converts total utilized investment of each type of transmission equipment into a cost per DS1. The appropriate termination equipment components are selected from the following list: Fiber Tip Cable, Fiber Patch Panel, Fiber Optic Terminal, DS3 Card, DS1 Card, OC3 Card, DSX3 Cross Connect, DSX1 Cross Connect Jack Field, Channel Bank, and Channel Bank Card. The following illustrates the termination equipment calculation:

[(Equipment Component Investment * Units Required) / DS1 Capacity] / Utilization Factor * (1+Power Factor) * Annual Charge Factor = Annual Cost Per DS1 by Equipment Component

Based on the ring characteristic, the following mileage equipment components are utilized, as appropriate, within the costing logic associated with the transit cost element: aerial fiber, underground fiber, buried fiber, pole lines and conduit. The following illustrates the mileage equipment calculation:

[(Unit Investment Per Mile * Units Required) / Fiber Utilization Factor] / Terminal Utilization Factor * Annual Charge Factor = Annual Cost Per DS1 by Equipment Component Per Mile

Annual Cost per DS1 by Equipment Component Per Mile * Fiber Mix Ratio = Weighted Annual Cost Per Mile by Equipment Component

Sum all components by the ring size and the result is a weighted annual cost per mile.

The cost per common transport is developed by taking the dedicated DS1 transport cost results and dividing the single termination and transit cost elements by 216,000 minutes. 216,000 minutes of use per DS1 is equal to 9,000 minutes of use per DS0 times 24 voice-grade circuits per DS1.

X. Results

Results are provided for dedicated and common transport on an individual ring basis, recognizing the use of existing LEC wire centers, mileage characteristics, and each ring's specific utilization. The common transport results are utilized in the development of universal service fund monthly transport cost per line by exchange. The dedicated and common transport results can also be utilized in establishing the cost of UNEs.

Transport Cost Proxy Model (TCPM)

Operating Company Number
Local Switch Name
CLLI Code of the Switch
V&H coordinates of the switch
CLLI code of the tandem serving the switch
Remote Offices the CLLI Code of the Host
Number Access Lines Served by the switch
V&H of the host (if a remote office) or tandem

Utilizes LERG data to develop the charateristics of a SONET Transport Ring required for input into the TCM Module.
Determines the size SONET terminal required based on traffic data at a given switch location.
Also, determines the number of fiber optic cable route miles required for the SONET ring architecture.

Maximum Number of Nodes Per Ring
Air to Route Mile factor
Line to Trunk Factor
Tandem Trunk Factor
Special Access Lines to Switched Lines
Maximum fill %
Minutes per DS1
Maximum Repeater Spacing
EAS/Exchange % of Minutes of Use
Material Costs

-Host w/all of its Remotes
-Tandem w/all of its Hosts

Route Name
Node Locations on Ring
Utilization
Segment Route Miles
Number of Repeaters
Terminal Size (OC3, OC12, OC48)

Fiber Optic Cable
Fiber Tip Cable
Fiber Patch Panel
Fiber Optic Terminals (OC-3, OC-12, and OC-48)
OC-3 Cards
DS-3 Cards
DS-1 Cards
Installation Cost
Utilization Factors
Pole and Conduit Factors
Annual Charge Factors
Aerial, Buried, Underground Mix

Route Name
Node Locations on Ring
Utilization
Segment Route Miles
Number of Repeaters
Terminal Size (OC3, OC12, OC48)

USF Monthly Transport Cost Per Line by Exchange

UNE Monthly Transport Cost (By Transport Ring)
Dedicated Transport (DS1, DS3)
Common Transport (Per MOU)